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(54) INJECTION MOULDING METHOD AND MACHINE

(71) We, BILLION S.A., a French corporate body, of 22 rue Brillat-Savarin, Oyonnax, Ain, France, do hereby declare

the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of and a machine for, the injection moulding of laminar articles, that is to say, articles formed from at least two materials of different composition, one of the materials enclosing another.

It has been proposed to injection mould articles consisting of two materials, by using a single distributor valve to which the two materials can be supplied alternately and which delivers into a common zone of the mould. The first material is injected into the mould and the second material is then injected within the first material so that the second material forces the first material against the wall of the mould to form the "skin" of the article.

This technique is suitable for the production of articles of small size and simple structure such as for example panels, but up to now difficulties have been encountered with articles of considerable width and length, especially articles having a complex structure.

In fact, with a single distributor valve delivering into a common zone of the mould, 1) It is not possible in practice to obtain a homogeneous distribution of the second material injected inside the "skin" which must enclose it, when laminar articles of large size are manufactured. This is explained by the fact that the materials are injected at a central point far from the extremities of the mould, so that the second material does not reach the end zones of the mould quickly enough to avoid premature solidification of the first material, which thus opposes any displacement of the internal material. Thus, there is a risk of obtaining badly-shaped articles in which the materials are badly distributed, over-thicknesses of the material forming the skin appearing at the periphery of the articles together with an undesirable thinning-down in the region of the common injection zone. 2) It is difficult to manufacture laminar articles of complicated shapes, comprising hollowed zones circumscribed by a continuous surrounding portion.

The present invention relates to a method which devlops the technique referred to above in such manner that it can be applied to the manufacture of laminar articles of complex structure and/or of large dimensions, and having at least locally, composite parts in which three are at least two materials of different compositions, one of which is enclosed by the other.

According to the invention, there is provided a method of injection moulding a laminar article formed from at least two materials of different composition, the method comprising injecting into at least two distinct zones of the mould cavity respective masses of a first material intended to constitute the skin of the article, then respective masses of a second material intended to form the core of the article, the masses of second material being injected so as to penetrate respectively within the corresponding masses of the first material whilst forcing the first material against the wall of the mould cavity and urging the masses injected respectively at the distinct zones towards each other, whereby the masses of first or skin material meet in a plane interposed between the masses of second or core material, and causing leakage of the skin material from the mould cavity in the region of the said plane so that the masses of second or core material become joined and mixed together.

With this method, the masses of second material become welded together, which would not occur without the said leakage, since otherwise a sheet of the first material would remain between them.

This is of particular advantage in the case where it is desired to obtain an article in which the core formed by the second material constitutes a homogeneous mass.

Preferably, in the zones of the mould in

which the composite parts of the article are formed, the mould is fed through multi-way distributor valves.

The present invention also relates to an injection-moulding machine for carrying the method of the invention into effect, this machine comprising a mould constituted by a fixed part and a moveable part, at least two separate supply systems for injecting at least two different materials into the mould and at least two distinct ducts for the injection of material into distinct zones of the mould, and means for connecting the ducts alternately to one and then the other supply system, the mould having at least one recess communicating with the mould cavity, extending somewhat transversely to the plane joining the fixed and moveable parts of the mould and being located in a zone remote from the angles of the mould cavity.

The multi-way valve which may be employed is advantageously of the type described in French Patent No. 1,290,262 of March 1st 1961, namely having two coaxial passages for materials to be injected or having more than two passages if so desired.

The types of materials which can be utilized may vary considerably. Thus, it would be possible to utilize materials of the same physical structure but having other different characteristics, or a combination of materials which may or may not include foaming agents, especially for the production of the core.

In order that the invention may be clearly understood and readily carried into effect, there will now be described by way of example, an embodiment thereof with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic general view of the injection assembly of an injection moulding machine;

Figure 2 is a diagrammatic detail to a larger scale, showing the arrangement of the injection head comprising multi-way distributor valves;

Figure 3a is a plan view of the moving portion of the mould employed with the machine shown in Figure 2, and

Figures 3b, 3c and 3d are diagrams illustrating the way in which the materials are distributed in the mould.

Figure 1 represents an injection assembly, the general structure of which is conventional and which will therefore not be described in detail.

On a frame 1 is mounted a fixed plate 2 supporting a mould part 2^1 and also a moving plate 3 carrying the other part 3^1 of the mould, capable of moving alternately in the direction of the arrow F on guiding rods 4 which are fixed. The assembly shown being intended to produce parts composed of two materials comprises two separate feed systems for the mould, indicated respectively at 5 and 6.

Again in a conventional manner, the supply systems are respectively constituted by a body in which is mounted rotatably under the action of a motor 7 or 7^1, a plastification screw 8 or 8^1 which is fed with raw material from a hopper 9 or 9^1 and which introduces the material into the mould in the molten form by the action of hydraulic jacks A or A^1. It will be noted that in the example shown, the screws 8 and 8^1 are superimposed and their bodies are mounted on one the other through an articulation axis 10. This constitutes an arrangement which is preferred but not essential.

There will now be described more precisely the injection nose of the press. At the end of the feed system 6 is mounted a member 11 extending into an orifice 12 of the fixed plate of the mould and to which is also coupled the nose of the feed system 5 by a fixing part 13 pierced with a channel 14 which extends the chamber of the screw 8. The part 11 is also pierced with two channels 15 and 16 respectively. The channel 15 causes the chamber of the screw 8^1 to communicate with a coupling member 17 joining the part 11 to a plate assembly indicated at 18 and which is fixed on the fixed plate 2, while the channel 16 causes the channel 14 of the member 13 to communicate with a second member 19 for coupling the member 11 to the plate assembly 18. In the plate assembly 18 are arranged identical distributor valves with two passages, indicated generally at 23 and which have a structure similar to that of the valve described in French Patent No. 1,290,262.

In the example shown, each of these distributor valves is constituted by a hollow housing 24 having opposite conical seatings 25 and 26 and in which is mounted in an axially-movable manner a member 27 playing the part of a valve.

The valve 27 has conical extremities 28—29 corresponding to the seatings 25—26, and a wide head 30 of the same section as the housing is in sliding contact with the wall of this latter, the head being extended by a portion 31 of smaller section.

The extremities of the housings 24 forming the seating 25 are connected to each other by a system of channels 32 connected in turn to the channel 33 of the member 17. On the other hand, the opposite extremities 26 of the housings are respectively extended by a discharge channel 34 or 35 opening into the fixed part of the mould, at two distinct zones of the mould, the moving part of the mould having a hollow impression "E" of the member to be moulded.

In addition, a second system of channels 36 communicating with the channel 37 of the member 1^0 is also connected to each

of the housings 24 in a zone located between the seatings 25—26 and forming a chamber between the inner wall of the housings and the reduced portion of the valve.

Finally, each valve 27 is pierced with an internal bore 38 opening at the two conical extremities 28—29. The valves being axially movable in their housings, it will be understood that when a mass of material is injected into the channels 32 coming from the supply system 6, the pressure of the material pushes the valve against its seating 26 which permits it to flow into the channels 38 and 35 (position shown in Figure 2).

On the other hand, as soon as the injection of material into the channel 32 is stopped and another material is injected into the channel 36, the pressure of the material pushes the valve back against its seating 25, which permits material to flow into the chamber surrounding the narrow portion 31 of the valve, and then into the channel 34.

Since with these arrangements the materials must flow through a fairly-long system of channels before being injected as masses into the mould cavity, in order to keep the materials at a suitable degree of viscosity, the said channels 32 and 36 are heated and for that purpose a heating system is provided in the plate 18, either electric or by circulation of a hot fluid.

It will be seen from Figure 1 that on the channels 14 and 15 which extend the screws 8 and 8^1, there are advantageously interposed spigot cocks 39—40, the operation of which is controlled by a transmission 41—42 in dependence on the operation of the screw with which they are associated. In other words, at the beginning of the movement of the screw for injection, the cock is automatically opened (position of the cock 39 of Figure 1) whereas it is closed at the end of the injection and as long as the screw is not actuated (position of the cock 40).

The arrangement shown in Figure 2 permits the manufacture of the articles having a homogeneous core "c" of a given material (in the form of foam or otherwise) coated with a skin "p" continuously formed from another material (see Figures 2 and 3). In order to permit of good homogeneity of the core "c", there is provided in the mould, at least at the plane where the two masses of material meet, a recess 43 extending substantially perpendicular to the joint plane X—X of the mould and permitting a leakage of a predetermined quantity of the material forming the skin out of the mould cavity.

The function of these notches 43 will be better understood by examining Figures 3b to 3d which show the course of the process of formation of a panel by means of two distributor valves, the discharge channels of which into the mould M have been simply indicated at N_1 and N_2.

According to this method, two masses P_1 and P_2 of a first material intended to form the skin are first injected through the channels N_1 and N_2. Subsequently, there is injected into the interior of each of the masses P_1 and P_2 a mass Q_1 and Q_2 of a second material, for example an expandable foam. As they expand, the masses Q_1 and Q_2 push back the first material in the direction of the arrows against the walls of the mould. In the central zone of the mould, the skins P_1 and P_2 come into contact as indicated in broken lines in Figure 3c.

It will be understood that in the absence of any possibility of leakage of the skins out of the mould chamber, these latter become welded together where they meet and prevent the material Q_1 and Q_2 from coming into contact with each other. There would thus remain in the final panel a sheet or line of first material embedded in the second material.

On the contrary, as shown in Figure 3d, by virtue of the recesses 43 provided in accordance with the invention, the materials Q_1 and Q_2 apply a continuous thrust on the skins and push them back into the recesses 43, thus permitting the formation of a continuous core.

It will be noted that it would also be possible, if this proved necessary, to provide recesses in the plane of the mould in the corners of the space intended to receive the material, like those which are indicated at 44 in Figure 3a. These recesses 44 permit a leakage of the material constituting the skin into the angles of the moulded piece, which avoids the formation of overthickneseses of skin in these zones. When once removed from the mould, the piece (shown in section in Figure 3a) has, at least in its central portion, one or more deadheads 45 generally shaped like a mushroom, which can be broken-off level with the wall of the piece, along the line X^1—X^1 for example.

The piece may also have identical deadheads 45^1 in its angles, and these deadheads can subsequently be broken-off so as to obtain an article with a uniform external wall.

It would of course be possible to have available several valves 27, depending on the article to be produced.

In the example which has just been described, the multi-way valves permit selective injection of the materials, that is to say the passage of only one material at a time.

WHAT WE CLAIM IS:—

1. A method of injection moulding a laminar article formed from at least two materials of different composition, the

method comprising injecting into at least two distinct zones of the mould cavity respective masses of a first material intended to constitute the skin of the article, then respective masses of a second material intended to form the core of the article, the masses of second material being injected so as to penetrate respectively within the corresponding masses of the first material whilst forcing the first material against the wall of the mould cavity and urging the masses injected respectively at the distinct zones towards each other, whereby the masses of first or skin material meet in a plane interposed between the masses of second or core material, and causing leakage of skin material from the mould cavity in the region of the said plane so that the masses of second or core material become joined and mixed together.

2. A method according to claim 1, in which the leakage of the skin material interposed between the masses of core material is produced by the pressure exerted by the masses of core material.

3. A method according to claim 1 or claim 2, in which injection of the first material is effected simultaneously into the two distinct zones of the mould cavity and subsequent injection of the second material is effected simultaneously into the two distinct zones of the mould.

4. An injection moulding machine for carrying out the method according to claim 1, comprising a mould constituted by a fixed part and a moveable part, at least two separate supply systems for injecting at least two different materials into the mould and at least two distinct ducts for the injection of material into distinct zones of the mould, and means for connecting the ducts alternately to one and then th other supply system, the mould having at least one recess communicating with the mould cavity, extending somewhat transversely to the plane joining the fixed and moveable parts of the mould and being located in a zone remote from the angles of the mould cavity.

5. A machine according to claim 4, in which at least one recess is formed in the fixed part or the moveable part of the mould.

6. A machine according to claim 4, in which at least one recess is formed in the fixed part and at least one recess in the movable part of the mould.

7. A machine according to any one of claims 4 to 6, in which the recess extends in a plane perpendicular to the plane joining the two parts of the mould.

8. A machine according to any one of claims 4 to 7, in which the recess is situated between the ducts for injecting the materials into the mould.

9. A machine according to any one of claims 3 to 8, in which the recess is constituted by a notch provided in the base of the mould cavity.

10. A method of injection moulding a complex article substantially as herein described with reference to the accompanying drawings.

11. An injection moulding machine substantially as herein described with reference to the accompanying drawings.

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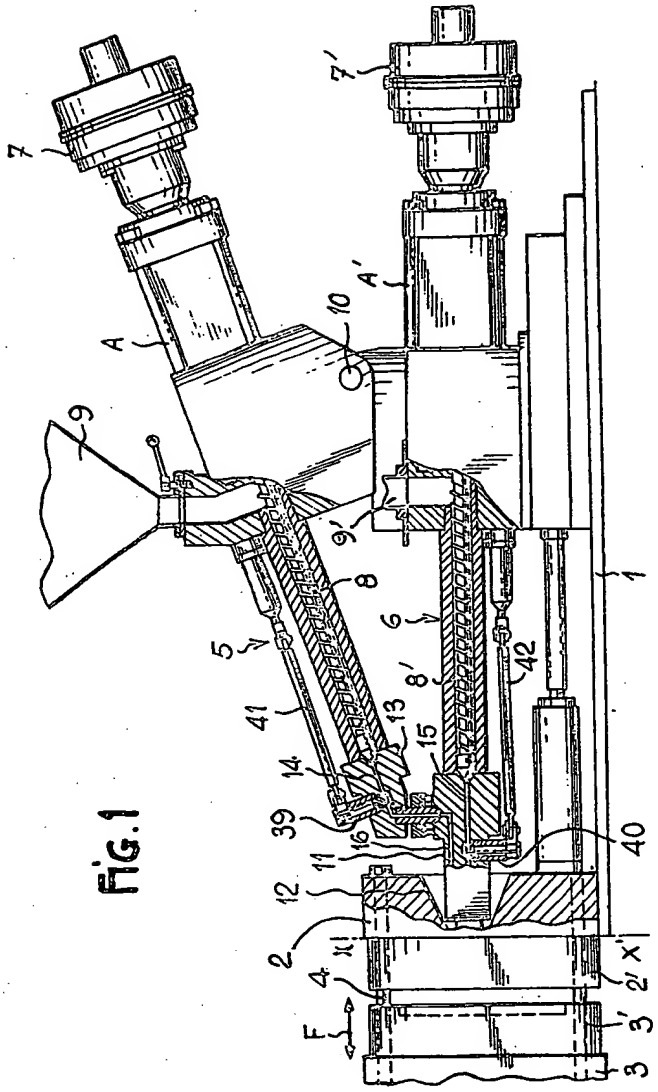

FIG.1

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Fig.2

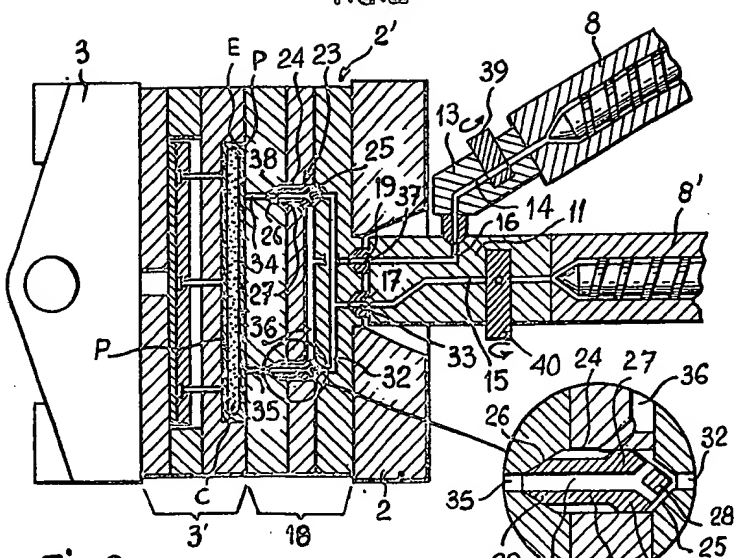
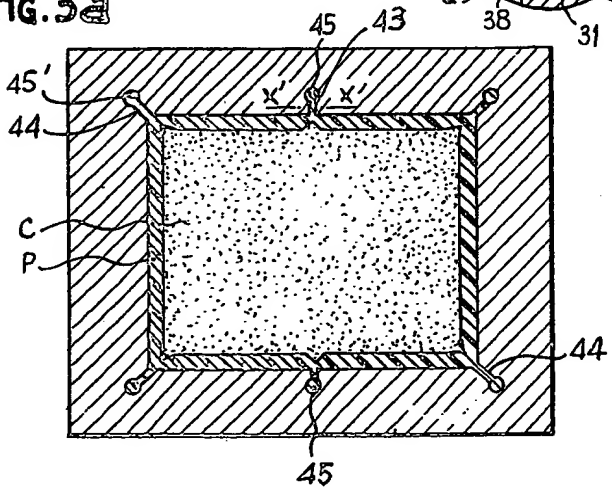


Fig.3a



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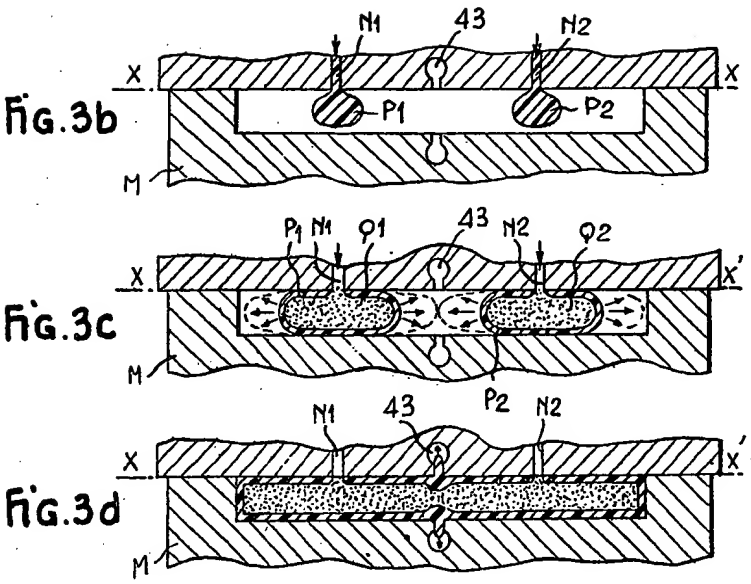

Fig.3b

Fig.3c

Fig.3d